Small-scale Forestry (2010) 9:501–516
DOI 10.1007/s11842-010-9140-0

A Systems Analysis of Factors Affecting Leakage in Reduced Emissions From Deforestation and Degradation Projects in Tropical Forests in Developing Nations

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Accepted: 16 September 2010 / Published online: 29 September 2010

Abstract This paper uses systems analysis to examine the factors that influence leakage in Reduced Emissions from Deforestation and Degradation (REDD) projects in tropical forest areas in developing countries. A causal loop diagram is used to identify some key intervention points for stakeholders to reduce the negative impacts of leakage. One of the most important intervention points identified is to provide livelihood alternatives to supplement the resources and the income that neighbouring small-scale landholders and communities must forego for the REDD initiative to be successful. The question remains, however, of how best to organise and distribute these resource allocations and payments to support the REDD project objectives. It is concluded that in many cases, developing countries with tropical forest coverage are unlikely to benefit from REDD in the foreseeable future, because of constraints related to economies of scale, but also because of political instability and lack of institutional capacity in many of these nations. Moreover, the risk remains that many of these developing countries will suffer from cross-border market leakage due to REDD projects conducted elsewhere, and that this will lead to negative local forest conservation and livelihood outcomes.

Keywords Carbon offsets · Avoided deforestation · Sustainable forest management · Voluntary carbon markets

Introduction

Leakage is one of five major constraints identified by Dargusch et al. (2010) to including Reduced Emissions from Deforestation and Degradation (REDD) projects within official UNFCCC regulated carbon markets. In the context of REDD, the

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term *leakage* has been defined by the Intergovernmental Panel on Climate Change (IPCC) in its special report on Land-Use, Land-Use Change and Forestry (LULUCF) as 'the indirect impact that a targeted land use, land-use change and forestry activity in a certain place at a certain time has on carbon storage at another place at another time' (Intergovernmental Panel on Climate Change (IPCC) 2000, section 2.3.5.2., p.71), and the 'unanticipated decrease or increase in GHG benefits outside of the project's accounting boundary··· as a result of project activities' (Intergovernmental Panel on Climate Change (IPCC) 2000, section 5.3.3. p. 246). Leakage in forest conservation initiatives is an intricate and multi-faceted phenomenon, manifesting itself in numerous ways including market impacts, human migrations, ecological feedback and product life-cycle changes (Schwarze et al. 2002; Spray and Moran 2006). Successful REDD projects require the effective control of leakage, which in turn requires that both proximate causes (e.g. land-use changes) and the underlying drivers (e.g. poverty, land tenure) of deforestation be addressed.

This paper uses a systems-thinking approach to analyse the factors associated with leakage in tropical forest conservation regimes. The analysis is undertaken in the context of a proposed REDD project within a tropical forest area in a developing country. The role of small-scale landholders, often viewed as the 'perpetrators' of forest degradation in REDD schemes, is given special attention. The factors affecting leakage in REDD schemes are reviewed and a systems-based conceptual model is presented. The paper concludes by identifying various intervention points that can be targeted to improve REDD project design and minimise the risk of leakage attributable to small-scale landholders and community groups.

Factors Affecting Leakage in Forest Conservation Projects

Leakage is often thought of as a project-based consequence although particular regulations and policies can also act as contributing factors. It can take place at various scales, with individual projects having greater relevance at the local scale and the cumulative effect of aggregate projects potentially contributing to the phenomenon at a global scale (Magnani et al. 2009; Kanninen et al. 2007). There are various types of leakage mechanisms, which may have negative as well as positive effects on forest conservation. *Primary* or *activity-shifting leakage* is occurs when an avoided deforestation project results in people leaving a project area to cut trees outside of the project boundaries. The movement of economic activity is associated with the movement of human and other forms of capital. *Secondary* or *market leakage* occurs when the unavailability of forest resources in avoided deforestation project areas results in more pressure to cut trees elsewhere. This type of leakage depends on the nature of the market and the scale of any project or policy. This mechanism is characterised by a change in the price of goods, influenced by net changes to production levels for a given regional distribution of activities. *Life-cycle leakage*, which also usually leads to positive forest conservation outcomes, occurs when industries adopt less polluting production methods as a result of the forest project (Sohngen and Brown 2004).

Murray et al. (2004)suggested incorporating provisions for deforestation activities in areas adjacent to project boundaries into a contract as a form of minimising the risk of activity-shifting leakage. Aukland et al. (2003) proposed that the provision of alternative livelihoods to baseline agents should be incorporated into project design. Project activities and discontinuation of baseline activities, such as commercial agriculture and logging, can result in market leakage. Market forces will determine whether the change in supply of forest and agricultural products has an effect on their price, which will in turn affect demand and possibly have a feedback effect on supply, such as a change in planting rates. Designing a project with minimal leakage requires intervention aimed at stakeholders involved in deforestation baseline driver activities. Furthermore, it requires an understanding of the motivations of these stakeholders, and effective monitoring of indicators (Berkes 2004).

Forest Use for Wood Products

Logging activity for the utilisation of wood products is one of the main drivers of deforestation worldwide and particularly in impoverished tropical forest areas, where forest resources are often the most readily accessible if not the only resource available to local communities (Geist and Lambin 2001; Sohngen and Brown 2004). The difficulties associated with effectively providing direct financial benefits from the value of ecosystem services have resulted in payments for ecosystem services being mostly ineffective in avoiding deforestation and degradation, as forests are cleared in favour of other activities that earn a higher opportunity cost.

Reduced supply of timber products from an REDD area may add pressure to the exploitation of timber supplies in other areas. While individual projects may not have the scale to affect levels of timber supply, the combined effect of several projects can lead to market leakage and therefore should be addressed at the policy level. The effect of reduced timber supply on price can also lead to additional tree planting in degraded areas, usually entailing a positive leakage effect. Small-scale timber extraction by individual users, driven by the need for forest products—e.g. for house building, fencing and boat building—is another driver of activity-shifting leakage. Local communities will require wood products for various needs, and unless an alternative source of wood products or alternative products is provided by a REDD project, some leakage can be expected (Gan and McCarl 2007).

Forest Use for Agricultural Development

Agriculture, both subsistence and commercial, is one of the strongest drivers of deforestation through its role in promoting land-use changes that result in the loss of forest cover. Agriculture can be a direct driver of deforestation, earning additional financial benefits from the initial exploitation of cleared timber, or a by-product of forest use for wood products where agricultural development benefits from the availability of forest-cleared land. Commercial agriculture poses a threat to REDD projects due to the risk of both activity-shifting leakage and market leakage. Commercial farmers and cattle ranchers will respond to the reduced availability of

land in a given area by relocating their activities to areas outside the project boundaries. In response to the reduced availability of land for agricultural activities and of supply of agricultural commodities, the stakeholder response (driven by higher prices) will be to intensify agricultural activities elsewhere, thus increasing GHG emissions (Ebeling and Yasue 2008).

Leakage is more relevant to subsistence agriculture at the project level, given that the baseline agents are subsistence farmers that usually have limited mobility. Activity-shifting leakage risks are particularly large if a project does not provide alternative income generating activities and food sources to affected local communities that rely on conversion of forest areas for subsistence agriculture production. The provision of alternative livelihoods for local communities can increase leakage if it attracts people from outside the original area of influences of the project or target group, by increasing the number of users and the impacts on the resource base (Burt and Clerk 1997).

Forest Use for Non-Timber Products

The use of forest resources by local communities is often related to traditional livelihoods, where precarious economic conditions and isolation have resulted in the reliance on non-timber forest products (NTFP) for subsistence needs such as food, medicine, cosmetics and fuel. Carbon leakage resulting from the use of NTFP is usually negligible in the short run because NTFP use usually depends on the permanence of forest ecosystems. However, excessive exploitation can lead to forest degradation and in the case of fuelwood use to deforestation, and to immediate release of carbon dioxide into the atmosphere. Reduced biodiversity is also a possible consequence, due to reduced food supplies for animal species that rely on NTFP (Brown and Durst 2003; Bettencourt et al. 2006).

Research Method

The research method involved a systems analysis of the factors affecting leakage in a proposed REDD project in a tropical forest area set within a developing country, such as a Pacific Island country. Systems analysis is a powerful tool in the study of observed phenomena that are caused by a large number of interacting factors often occurring at different levels of causality and separated in space and time, such as is commonly the case with deforestation (Geist and Lambin 2001). Systems analysis is carried out by creating operational maps and simulation models representing the mental models that capture the interrelationships of physical and behavioural processes, organisational boundaries, management policies, information-feedback and time delays. The resulting maps and models can be used to simulate alternative actions and test the holistic outcome. These need not all be undertaken, depending upon the nature of the intervention, the data available and the effort committed (Maani and Cavana 2007). For the purpose of this paper, the analysis of factors affecting leakage in REDD projects in developing nations will not cover the complete systems analysis methodology in all its phases. In the interest of brevity

and in accordance with the limited data available, this analysis will rely on causal loop modelling with no quantitative data employed.

A causal loop diagram (CLD) can be used as a tool for describing causal relationships among variables (or factors) operating within a system (Maani and Cavana 2007). A causal loop is a conceptual tool, used to describe a dynamic process in which the chain effects of a cause can be traced, through a set of related variables, back to the original cause. CLDs are formed of variables (factors) and links (arrows), which indicate a causal association between two variables. To determine the nature of the causal relationship established between two variables, there are two possible arrangements. Tthe variables move in the same direction, whereby an increase (or decrease) in variable X will cause an increase (or decrease) in variable Y. This is denoted by a 's' notation at the head of the arrow. Alternatively, the two variables move in the opposite direction, where an increase (or decrease) in variable X, will cause a decrease (or increase) in variable Y, denoted by an 'o' notation at the head of the arrow.

Causal loops must necessarily form a closed path, though they need not be circular and variables that are not part of the loop can be included in the model. There are two types of causal loop, determined by the nature of the feedback that governs them. *Reinforcing* (R) or positive feedback, represent growing or declining actions of a compounding nature, commonly associated with virtuous or vicious cycles. Reinforcing loops are denoted by the letter 'R' inside the loop. *Balancing* (B) loops seek stabilizing action or a return to control, possibly aiming for a specified target. They are also referred to as counteracting or negative feedback loops, and are denoted by the letter 'B' inside the loop.

The systems map was constructed from mental models based on the underlying causes of deforestation and how these can affect leakage. According to Maani and Cavana (2007), mental models reflect personal beliefs, values and assumptions, and provide underlying behavioural motivations for the patterns observed. Given the personal and subjective nature of mental models, the systems map presented here is not meant to provide an indisputable systems map for this context, but rather one that will reflect the authors' understanding of causal relations between the factors presented. The factors selected do not comprise an exhaustible nor exclusive list of possible factors affecting leakage in REDD projects in developing nations at a generic level, and have been chosen because of the insights they provide to some fundamental leverage points in avoiding leakage.

A Conceptual Model of the Factors Influencing Leakage in REDD Projects

The conceptual model constructed to analyse factors that pose risk of leakage in REDD projects is presented in the form of a CLD (Fig. 1), with the main loops in that diagram analysed and discussed in this section. The CLD was constructed utilising the Vensim® PLE for Windows software, published by Ventana Systems Inc. The model reflects the ideas and information presented in the literature review and in the analysis of factors that influence leakage. For a complete description of factors refer to Appendix. The various factors affecting leakage are in turn affected

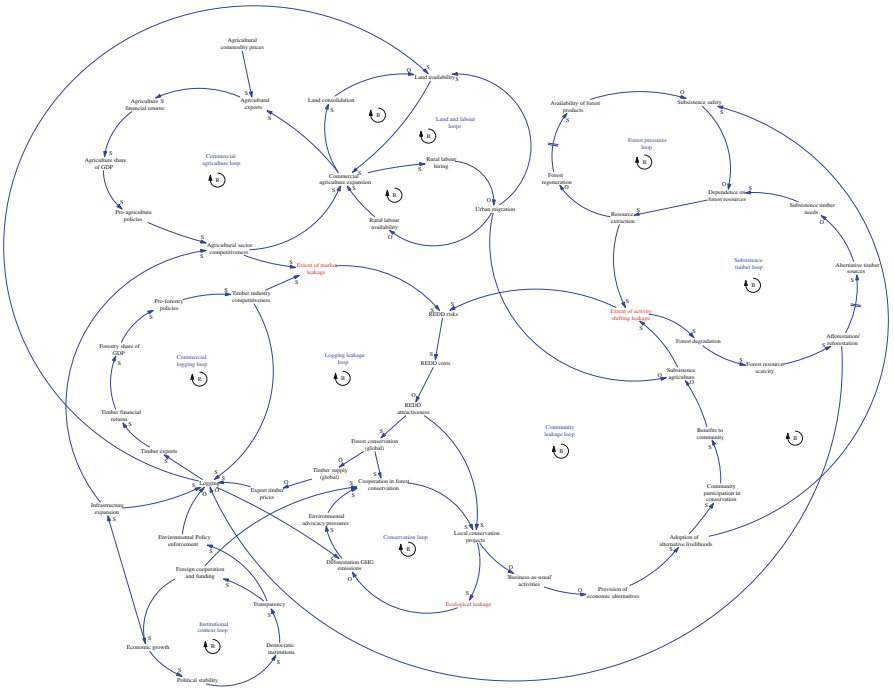

Fig. 1 *Causal loop* diagram of the factors influencing leakage in REDD projects

by multiple other factors, and as such can form part of multiple loops. The focal points of the CLD are the factors labelled *Extent of market leakage* and *Extent of activity-shifting leakage*, both of which lead up to the fundamental aspect of analysis in this paper, namely *REDD risks*.

Commercial Logging Loop

The commercial logging loop considers factors at several scales, both local and global, which reflect the influence of international markets for timber, through the effects that international demand and commodity prices for timber products have on developing countries' timber industries. This loop demonstrates the reinforcing feedback that governs the growth of the logging industry, and the importance that export markets have in this cycle. In this loop, an increase in timber exports leads to an increase in the financial returns from logging activities (see Dudley 2004). As this takes place, the growing relative importance of logging to developing countries' economic growth is likely to create a more favourable institutional environment, reflected by growing subsidies, availability of extension services, investment and fiscal stimulus (Asian Development Bank 2009). The combination of the aforementioned factors leads to increased competitiveness of developing countries' timber industries, feeding back into the cycle and promoting increased volumes of logging.

Logging Leakage Loop

One of the factors that can affect the extent of logging in developing countries is the price of export timber, as governed by international timber market dynamics (Fiddaman 2002, 2007). The logging leakage loop extends the analysis of factors presented in the commercial logging loop by adding factors that demonstrate the effect of REDD projects in timber markets, and by modelling how they affect market leakage. This loop presents a balancing dynamic, whereby the opportunities presented in REDD projects provide countering incentives to the expansion of commercial logging activities.

Following from where the commercial logging loop completes its full cycle, the extent of market leakage is affected by the competitiveness of the developing countries' timber industries, because opportunities for compensating the reduced supply of timber products as a result of REDD initiatives will be more pervasive where there is an established and competitive industry. The extent of market leakage is an important factor when assessing the risks of an REDD project providing effective GHG emissions abatement. These risks will in turn be crucial in determining the costs of REDD projects, because the control systems that need to be established to avoid and monitor effective market leakage give rise to additional costs. The costs of establishing a REDD project are fundamental to assessing the attractiveness of REDD vis-s-vis other CDM mechanisms and emissions abatement options available to carbon market participants in meeting their emission reduction goals.

Subsistence Timber Loop

Forestry activities of a non-commercial nature also affect leakage in REDD projects, albeit at the activity-shifting level given the baseline agents of this type of leakage are local communities. In the model, unlike the commercial timber and logging leakage loops, this loop deals exclusively with factors that are local in scope even though activity-shifting leakage leads to the degradation of forest environments in locations that are both adjacent to and geographically isolated from the REDD project area. This loop presents a balancing dynamic whereby the degradation of forest environments through subsistence timber extraction prompts a response to conserve and limit the extent of degradation to which they are submitted.

Communities and small landholders require timber for various purposes tied to their subsistence needs, and the continuous extraction of timber from unprotected forest areas leads to degradation (Carter and Gronow 2005). Mounting degradation in turn leads to forest resource scarcity, eventually requiring that timber plantings be established in order to sustainably meet local timber demand. The establishment of forest plantations poses high uncertainty of returns given the long-term nature of the investment and is usually driven by other interests. Plantations are likely where natural forest timber is sparsely available due to over-extraction or protection status and will play an important part in the livelihoods of forest dwelling communities. The use of plantation timber is only possible after a number of years as trees mature.

The reduced pressure over these ecosystems and lower intensiveness of resource extraction limit the extent of market and of activity-shifting leakage that takes place.

Forest Pressures Loop

Closely linked to the subsistence timber loop is the forest pressures loop, which governs the response of a forest ecosystem to community forest resource extraction pressures. The intensiveness of subsistence timber use pressures is a determinant of natural forest long-term and continuous provision of resources and services that contribute to the food and resource safety of associated communities. The need for ensuring this subsistence safety in the long term drives the balancing nature of this loop, reducing pressure over forest resources and enabling them to regenerate.

Agricultural development

Besides timber exploration, land-use changes are the predominant drivers of deforestation, where agriculture is the most common land use adopted in areas where natural forests have been cleared (Food and Agriculture Organisation of the United Nations (FAO) 2004, 2005, 2009). As with timber exploration, there is an important distinction made between commercial and subsistence agricultural activities, with the former being conducive to market leakage and the latter to activity-shifting leakage. Closely related to agricultural activities are the land and labour loops, and the increasing demands for these inputs needed for the expansion of agricultural activities.

Commercial Agriculture Loop

Markets are becoming increasingly interconnected at the global level as trade facilities and the technology available become increasingly sophisticated. The drivers of commercial agriculture reflect this complexity through a combination of local and global factors that have profound effects on developing countries' agricultural activity patterns. The commercial agricultural loop in this model presents a reinforcing cycle in which growth drives further growth and conversely contraction drives further retrenchment of agricultural activities.

The relative competitiveness of the agricultural sector in developing countries' economies will determine the extent to which agricultural activity is able to expand within these countries, given it competes with other economic activities for land, labour and finance resources. Expansion of agriculture increases production, which combined with the incentives provided by rising agricultural commodity prices in international markets, leads to increases in agricultural exports and export revenue. A rise in revenue originating from agricultural activities generates stimulus for government and other institutions to provide more agricultural support, such as subsidies, training, extension services, investment and fiscal stimulus. These measures further increase the international competitiveness of the agricultural sector, so that market leakage as a result of commercial agriculture expansion becomes more likely. As agriculture becomes more competitive, rising opportunity

costs of conservation lead to market leakage, adding to the risks and costs of REDD projects and making them less attractive to carbon market players.

Land and Labour Loops

The availability of land and labour are fundamental to enable the expansion of commercial agriculture. In this model, the complex interplay between land, labour and agriculture has produced three smaller loops which can act to reinforce agricultural expansion, or limit it through a balancing effect (Kindermann et al. 2008). Logging is an important process in forested areas that is not directly linked to agricultural activities, but is a determinant (in fact, almost a prerequisite) to land availability and consequently to the expansion of agricultural activities. Areas logged for timber will usually become available for agricultural purposes, increasing revenue to loggers and facilitating the activities of farmers, who need little additional effort in preparing the land for conversion to pastures and crops.

The economies of scale associated with commercial agriculture require extensive land areas, and smaller plots can be consolidated into larger ones for agricultural production to enhance profitability. However, the limited and finite nature of land resources imposes limits to growth so that as more consolidation takes place, less suitable and more costly land remains for further agricultural expansion.

The income earned by rural labourers in commercial agriculture is an important component of the rural household budget which in many cases will ensure the sustainability of the rural household and break the cycle of rural poverty that ultimately results in urban migration. Because households and populations are able to sustain themselves in rural areas, more rural labour (other household members) is available for further expansion of commercial agriculture. As households are able to supplement their small-scale rural activities with the income contribution of paid labour, less land becomes available for consolidation and expansion of commercial plots.

Non-Timber Forest Products

Besides forestry and agriculture, the community dynamics, the institutional context and other non-timber forest values influence the occurrence of leakage within the scope of the model constructed. The influence of these factors on leakage may not be as direct as the forestry and agricultural activity related loops presented earlier, although the factors within them bridge important links among the various loops in the model.

Institutional Context Loop

The institutional context loop is particularly important in developing countries given the existence of fragile democracies and authoritarian regimes in the region. The reinforcing loop presented in the model demonstrates a potentially vicious cycle which undermines political and economic conditions and may ultimately be the most crucial aspect in determining whether REDD projects are to become feasible.

Under turbulent conditions, it is extremely unlikely that any REDD initiatives will be undertaken in a developing country, because the institutional risks create too much uncertainty, both in the short and the long term.

A lack of political stability is likely to weaken the democratic institutions of a country, reducing the transparency of political activities, which become more susceptible to corruption and self-serving interests. The lack of transparency affects the willingness of foreign aid providers and development agencies to invest and collaborate in the national development agenda, thus having a negative impact on economic growth, which further erodes political stability. The lack of transparency also affects developing country institution's ability to monitor effectively and enforce environmental policies. This can increase the amount of logging taking place, particularly illegal and unsustainable logging, thus affecting the commercial logging and the logging leakage loops.

The reduced economic growth resulting from the institutional context loop also affects the infrastructure expansion in developing countries, reducing logging pressure and export infrastructure. The same effect is observed in the competitiveness of the agricultural sector due to reduced transport and export infrastructure.

Conservation Loop

The conservation loop represents a counterforce to the drivers of leakage, with potential to contribute towards leakage prevention and even positive ecological leakage. Nonetheless, the strong influence of factors from other loops, combined with the weak influence of the factors present in this balancing loop, suggest that conservation initiatives in their current form are not enough to impede or diminish leakage in eventual REDD projects.

The dynamic in this loop implies that as GHG emissions from deforestation continue to rise (as a result of continued logging and land-use conversion), the pressure from environmental advocates from all sectors of society (both local and global) will urge a pact for forest conservation, whether encompassing REDD or not. Cooperation in forest conservation should stimulate a transfer of technology, financial incentives (whether in the form of carbon credits or otherwise), which will support the adoption of conservation initiatives in developing countries. This process can lead to positive ecological leakage with benefits to the integrity of areas adjacent to conserved areas and to reducing aggregate levels of GHG emissions from deforestation.

Community Leakage Loop

The involvement of forest dwelling communities in the design, maintenance and benefit-sharing of conservation initiatives is crucial to limiting the risk of activity-shifting leakage, particularly where land tenure is unclear or predominantly under customary ownership. These factors are reflected in the balancing loop labelled community leakage loop, where activity-shifting leakage and the risks to REDD are reduced by involving and providing economic alternatives to communities unable to continue to exploit forest resources for their subsistence needs (Berkes 2004).

The adoption of conservation initiatives in a developing country affects communities' ability to continue their usual activities, likely to be reliant on forest resources and to some extent on forest conversion to agricultural land. This negative 'income effect' demands that economic alternatives be provided, enabling communities to adopt alternative livelihoods which will support rather than jeopardise conservation goals. For example, community members can be trained and hired to act as rangers and stewards of protected areas, or participate in the development and implementation of ecotourism activities. The adoption of alternative livelihood options should stimulate greater interest and participation of the community in conservation. These provisions can positively influence REDD project proponents to extend contracts with local groups to avoid leakage activities in areas adjacent to project boundaries, as well as reduce their requirements from subsistence agriculture. This in turn reduces the extent of activity-shifting leakage, especially where a project can demonstrate that reconciling conservation with small landholder and community livelihoods is possible.

Conclusion

The conceptual analysis of leakage attributable to small-scale and community landholders in a REDD project in the context of developing countries provides an insightful tool to understand better some of the factors and mechanisms that come into play, both at the global and local level, in natural-forest-based carbon capture projects. Conclusions to be drawn from the analysis are weakened by the low availability of active REDD projects on which to base the study and collect data. The lack of clarity and definition with regard to the REDD policy environment and how these projects fit in with current schemes for reducing GHG emissions adds further uncertainty to this modelling. Continuing discussions and negotiations leading up to the 2010 UNFCCC Conference of Parties meeting in Cancun will likely re-shape the circumstances for REDD projects when compared to those currently in experimentation in voluntary markets, potentially altering principles upon which this analysis is based. Nonetheless, some interesting dynamics and leverage points have emerged that provide useful insights for REDD projects designed and implemented in a similar setting to the one described, whatever the final policy design may become.

The factors that influence market leakage are largely independent of small landholder and community-based activities, and are subject to global market dynamics and to both commercial and national interests. Still, commercial agriculture and timber harvesting activities provide indirect influences on small-scale landholders and communities, influencing rural migration patterns and consequently land-use change patterns. Small-scale landholders and communities are directly linked to activity-shifting leakage and the model presents several intervention points to reduce these risks, supported by both the literature and case studies of other REDD type projects in different contexts (e.g. Asquith et al. 2002; Wunder 2008).

One of the most relevant leverage points to avoid leakage in REDD projects from small-scale landholders and communities is to engage these agents in the conservation initiative, respecting their rights as customary landowners, even if a government agency or consortium is the designated negotiating party in an REDD project. Doing so at an early stage in project design, with ample consultation and input allowed, will not only improve these agents' understanding of project goals but also instil in them a sense of ownership. This can be further enhanced by acting upon another leverage point, which is the equitable sharing of the benefits that arise from the conservation initiative (in this case the payments or dividends from the carbon credits generated) with these agents. By ensuring they have not only a clear understanding of the project but also a vested interest in its success, the risks of leakage can be minimised, especially if all these conditions and accords are formalised in a contract.

Activity-shifting leakage by small-scale landholders and communities is usually driven by subsistence needs, as forest resources are exploited for food, fuel and materials to complement household income. It is therefore imperative to provide alternatives (such as employment, subsidies and investment) to supplement the resources and the income that these agents must forego if the conservation initiative is to be successful. In many countries, the growing tourism industry provides an excellent opportunity for alternative employment, although with a need for continued training and capacity building. If the previous recommendation of involving and allowing input from these agents is followed, then it is more likely that the alternatives provided will be within their interest and capabilities, and therefore more likely to be adopted in support of forest conservation.

It is unrealistic to expect that providing economic alternatives and activities will lead to a complete cessation of resource extraction, for which some leeway must be made in establishing a project baseline. Providing alternative sources of resources is therefore another important leverage point in avoiding leakage (Cacho et al. 2008). Some developing countries are already establishing large plantation forest areas (Hamilton et al. 2007), although these are primarily of high-value commercial tree species. Expansion of these plantations to degraded areas, for provision of low-cost timber and other forest resources for local use, are fundamental for reducing leakage.

Appendix: Description of Variables

Adoption of alternative livelihoods: uptake of activities other than traditional subsistence activities by forest dwelling communities.
Afforestation/reforestation: establishment of commercial forestry activities.
Agricultural sector competitiveness: relative importance of the agricultural sector to the developing country's economy.
Agricultural exports: agricultural commodity exports.
Agriculture financial returns: profits from agricultural activities.
Agriculture share of GDP: contribution of agriculture to the developing country's economy.

Alternative timber sources: availability of timber other than from natural forests.
Availability of forest products: availability of non-timber forest products.
Benefits to community: the benefits accrued from conservation projects to forest dwelling communities.
'Business-as-usual' activities: extent to which forest-resource intensive activities that usually take place if there are no conservation initiatives in the area are pursued.
Commercial agriculture expansion: land and resources dedicated to commercial agriculture activities.
Community participation in conservation: involvement and co-management of forest conservation initiatives by forest dwelling communities.
Cooperation in forest conservation: provision of technical knowledge and resources for forest conservation by government agencies and international development agencies.
Deforestation GHG emissions: greenhouse gas emissions resulting from deforestation activities.
Democratic institutions: existence of social, political and economic institutions characteristic of democratic regimes.
Dependence on forest resources: reliance of forest dwelling communities on timber and other forest resources for their livelihoods.
Ecological leakage: beneficial environmental leakage to areas adjacent to conservation projects.
Economic growth: rise in levels of economic activity, as measured by the Gross Domestic Product (GDP).
Environmental advocacy pressure: environmental advocacy and campaigning for mitigating deforestation impacts.
Environmental policy enforcement: extent to which environmental protection policies are upheld (relative measure of government and third-parties ability to monitor, command and control).
Export timber prices: international market prices for timber commodities.
Extent of activity-shifting leakage: primary leakage attributed to forest dwelling communities.
Extent of market leakage: secondary leakage attributed to agricultural and timber market prices and equilibrium conditions.
Foreign cooperation and funding: provision of technical and financial assistance for PICTs development.
Forest conservation (global): extent of forest conservation initiatives worldwide.
Forest degradation: extent of damage to the structure and function of natural forest ecosystems.
Forest regeneration: extent of recovery of natural forest ecosystems post-disturbance.
Forest resource scarcity: relative measure of the difficulty to locate and extract forest resources.
Forestry share of GDP: relative measure of forestry activities contribution to GDP.

Infrastructure expansion: extent of infrastructure provision, including roads, ports, communications, market facilities, etc.
Land availability: extent of land available for agricultural activities.
Land consolidation: extent of process of consolidation of small-holder and communal land plots into commercial plots.
Local conservation projects: forest conservation initiatives within a developing country.
Logging: deforestation of natural forests by forestry sector activities.
Political stability: extent to which the political regime upholds a stable, democratic process.
Pro-agriculture policies: extent to which policies support agricultural activities, through subsidies, government investments and other facilities.
Pro-forestry policies: extent to which policies support forestry activities, through subsidies, government investments and other facilities.
Provision of economic alternatives: extent to which alternatives to 'business-as-usual' activities that have a low or no impact on forest resources are presented to forest dwelling communities.
REDD attractiveness: relative appeal of REDD projects to investors in international carbon markets.
REDD costs: relative costs of REDD projects, including opportunity costs and on-going project costs.
REDD risks: relative risks associated to REDD projects, including leakage and permanence.
Resource extraction: extent to which forest resources, including non-timber forest products and fuelwood, are used by forest dwelling communities.
Rural labour availability: unemployed or under-employed rural populace.
Rural labour hiring: extent to which unemployed or under-employed rural populace are hired to perform in agricultural and forestry activities.
Subsistence agriculture: rural household production to meet resource and food needs.
Subsistence safety: Extent to which rural households resource and food safety needs are met.
Subsistence timber needs: rural household requirements for timber, including fuelwood, building material, fencing, etc.
Timber exports: timber production that is sold in international timber markets.
Timber financial returns: profits from forestry activity.
Timber Industry competitiveness: relative importance of the forestry sector to the developing country's economy.
Timber supply (global): aggregate global supply of timber.
Transparency: extent to which government policies and measures are carried out in an open, communicative and accountable manner (relative measure of corruption).
Urban migration: extent of rural exodus.

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